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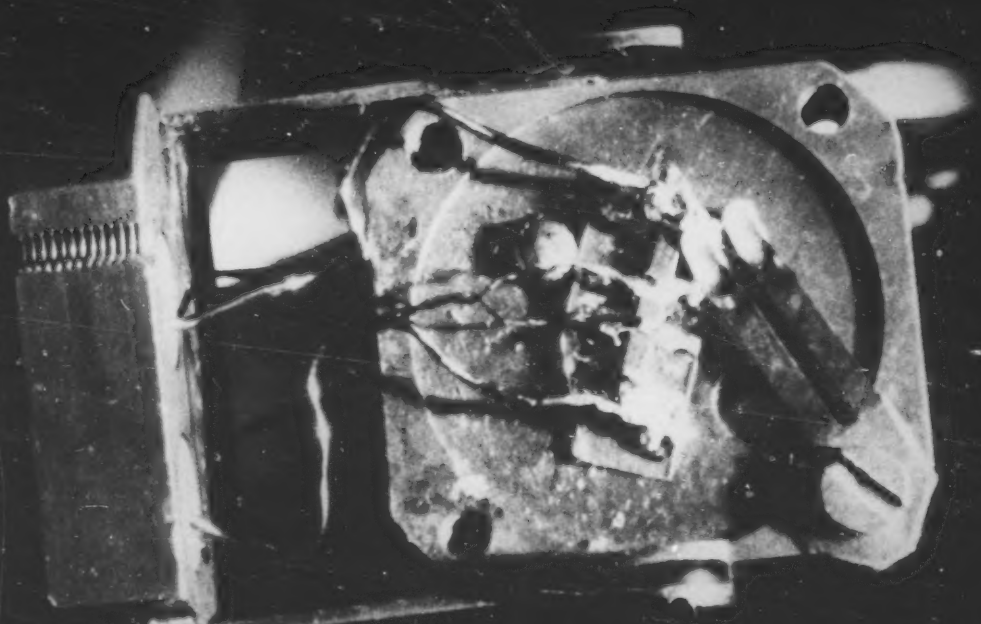

Superconductivity

The search for a national policy

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News Focus

Superconductivity drive ignites technology policy debates over need for coordinated government-industry-university programs and for stronger U.S.-Japan research relations. **Page 10**

Revenues Continue To Increase For Biotechnology Firms

Buoyed by growing product sales, licensing fees, and research agreements, financial outlook brightened for most firms in second quarter

William J. Storck, C&EN New York

Increasing product sales and healthier research contracts helped swell revenues at biotechnology firms in the second quarter and, in a few cases, these higher sales increased profitability. The companies registering profits in the second quarter include Biotech Research, Calgene, Centocor, Genentech, Genetics Institute, Genzyme, Molecular Genetics, and Repligen.

Even at companies with little or no sales of products, development is proceeding at such a pace that manufacturing facilities are being built in anticipation of future commercial products.

For 20 U.S. biotechnology firms surveyed by C&EN, revenues for the second quarter increased an average of 42% from the same period in 1986 to a total of $122 million. Although there was still an aggregate loss for the 20 firms, it narrowed considerably to just $361,000 from $11.1 million in the second quarter of 1986. Revenues include product sales, contract research, royalties, and interest revenues.

For the first six months of the year, revenues for the 20 companies totaled almost $234.0 million, up about 39% from the same period in 1986. However, losses for the companies grew, totaling $30.9 million in the first six months, compared with $20.2 million in the year-earlier period.

For the seven companies reporting product sales—Calgene, Cetus, Genentech, Genzyme, Molecular Genetics, Monoclonal Antibodies, and Ribi ImmunoChem, these sales increased almost 90% to $29.3 million in the second quarter from the same period in 1986. Chief among these was Calgene, whose product sales soared 381% to about $4.2 million in the second quarter. Product sales now

Second-quarter revenues rose an average of 42% for 20 biotechnology firms

	SECOND-QUARTER 1987						FIRST-HALF 1987					
	Revenues[a] ($ millions)	Earnings[b] ($ millions)	Change from 1986 Revenues	Change from 1986 Earnings	Profit margin[c] 1987	Profit margin[c] 1986	Revenues[a] ($ millions)	Earnings[b] ($ millions)	Change from 1986 Revenues	Change from 1986 Earnings	Profit margin[c] 1987	Profit margin[c] 1986
Biogen	$ 2.659	$−6.632	−7%	def	def	def	$ 6.644	$−12.221	0%	def	def	def
Biotech Research	2.339	0.11	66	def	4.7%	def	4.329	0.183	56	def	4.2%	def
Calgene	6.593	0.84	214	def	12.7	def	13.946	1.333	321	def	9.6	def
California Biotechnology	3.059	−1.742	−21	def	def	1.7%	6.072	−3.326	−15	def	def	def
Centocor	11.873	5.803	49	321%	48.9	17.3	23.819	7.351	64	190%	30.9	17.5%
Cetus	15.426	−1.99	23	def	def	0.1	29.029	−2.936	5	def	def	1.4
Cytogen	2.373	−0.491	317	def	def	def	4.891	−0.771	493	def	def	def
DNA Plant Technology	1.903	−0.172	15	def	def	3.5	3.708	−0.257	25	def	def	1.0
Damon Biotech	1.308	−2.116	2	def	def	def	3.113	−2.201	35	def	def	def
Genentech	47.504	5.695	46	102	12.0	8.7	86.11	8.926	40	95	10.4	7.4
Genetics Institute	4.367	2.573	−10	148	58.9	21.3	9.638	3.861	4	97	40.3	21.2
Genzyme	4.314	0.081	45	def	1.9	def	8.402	0.133	41	def	1.6	def
Immunex	3.638	−0.623	67	def	def	def	7.138	−0.934	105	def	def	def
Integrated Genetics	2.765	−0.896	238	def	def	def	6.171	−0.76	238	def	def	def
Liposome	0.878	−1.856	39	def	def	def	1.75	−3.347	40	def	def	def
Molecular Genetics	1.982	2.413	25	def	121.7	def	4.195	1.507	−3	def	35.9	def
Monoclonal Antibodies	0.75	−4.166	−69	def	def	5.7	2.303	−9.596	−54	def	def	6.4
Repligen	6.024	3.035	519	def	50.4	def	7.562	−17.569	261	def	def	def
Ribi ImmunoChem	0.408	−0.151	−1	def	def	def	0.839	−0.284	4	def	def	def
Synergen	2.066	−0.076	3	def	def	3.2	4.322	0.005	2	−99	0.1	8.6

a Includes sales, contract research, royalty, and interest revenues. b Excludes extraordinary and nonrecurring items where possible. c After-tax income as a percentage of sales. def = deficit.

Biotechnology product sales are still scarce

	Product sales[a] ($ millions)	% change from 1986	Sales as % of total revenues 1987	1986
Biogen	$ 0	nm	nm	nm
Biotech Research	na	na	na	na
Calgene	4.244	381%	64%	42%
California Biotechnology	0	nm	nm	nm
Centocor	na	na	na	na
Cetus	1.138	105	7	4
Cytogen	0	nm	nm	nm
DNA Plant Technology	0	nm	nm	nm
Damon Biotech	0	nm	nm	nm
Genentech	20.008	111	42	29
Genetics Institute	0	nm	nm	nm
Genzyme	3.133	31	73	80
Immunex	na	na	na	na
Integrated Genetics	0	nm	nm	nm
Liposome	0	nm	nm	nm
Molecular Genetics	0.108	5	5	7
Monoclonal Antibodies	0.550	−71	73	78
Repligen	0	nm	nm	nm
Ribi ImmunoChem	0.101	−21	25	31
Synergen	0	nm	nm	nm

a For second-quarter 1987. nm = not meaningful. na = not available.

make up about 64% of the firm's revenues, compared with 42% in second-quarter 1986. Genentech also had strong product sales, with a 111% increase to about $20 million, accounting for about 42% of its total revenues. In the second quarter last year, product sales made up 29% of total Genentech revenues.

Product sales at Cetus more than doubled to $1.14 million, a 105% gain from 1986. In spite of this increase, product sales still make up just 7% of Cetus' total revenues. In second-quarter 1986, the share was 4%.

Genzyme also recorded significant growth in its product sales, up 31% to $3.13 million. In spite of this hefty rise, its product sales as a percentage of total revenues dropped to 73% in the second quarter from 80% in the same period last year. Genzyme's president and chief executive officer Henri Termeer says, "We are very pleased with the strong growth of our product sales in the second quarter. Amylase related reagents have grown to be Genzyme's biggest single product, and six new products introduced in the first half as research reagents have kept the growth of that business high."

At Calgene, product sales come primarily, if not totally, from its wholly owned cottonseed subsidiary, Stoneville Pedigreed Seed Co., and this subsidiary was a major factor in Calgene's profitability for the quarter. However, because seeds are a seasonal business and Stoneville operates at a profit only in the second and third fiscal quarters (first and second calendar quarters), Calgene says it will report a loss in its fourth fiscal quarter. Still, it expects a modest profit for the fiscal year.

Genentech's increase in product sales in the second quarter was due primarily to higher sales of Protropin, its human growth hormone.

The biotechnology industry is progressing well enough that a few companies are planning production facilities. At Boulder, Colo.-based Synergen, Larry Soll, president and chief executive officer, says, "Synergen has achieved a major milestone during the second quarter of 1987 with the completion of its $4 million pilot production plant. We plan to produce recombinant human proteins for clinical trials, including our elastase inhibitor and angiogenesis factor, in the new facility."

Cetus president and chief executive officer Robert A. Fildes comments, "We expect to invest approximately $42 million in capital assets over the next two years, principally to complete additional pharmaceutical manufacturing facility construction projects, which have begun at our Emeryville, Calif., and Amsterdam, the Netherlands, locations."

Research contracts and interest payments continue to provide benefits at many firms. At Liposome Co., Princeton, N.J., second-quarter revenues include a 19% increase in collaborative research revenues and a 90% increase in interest income.

At Cytogen, based near Princeton, a collaborative agreement with Eastman Kodak provided most of the company's second-quarter contract revenues, and interest income increased $637,000 over the same quarter a year ago.

Ronald J. Brenner, president and chief executive officer of Cytogen, says, "The joint development program of our targeted radioisotopic cancer imaging technology with Kodak is now in the human clinical testing phase and continues to make encouraging progress. As a result, it has been agreed that the present rate of funding will be maintained for the balance of 1987, and this level of funding by Kodak is expected to continue in 1988."

Other biotech firms also noted clinical testing activities. For example, Liposome reports that it has entered into human clinical trials with an anticancer drug—a liposomal formulation of doxorubicin—in terminally ill patients in an Ontario, Canada, cancer center. Liposome chairman and chief executive officer Edgar T. Mertz says, "It's a very important day in the life of a biotechnology company when it enters human testing. It is further evidence that we are moving closer to our goal of becoming a fully-integrated pharmaceutical company."

Genzyme reports that its first therapeutic product, a treatment for Gaucher's disease, a hereditary metabolic disorder, is doing well in clinical trials and is expected to be introduced in 1989. The company is currently raising a $10 million R&D limited partnership to fund the development of this program. □

NSF Report Provides Extensive Data About Chemists, Chemistry

Based on three major surveys, study characterizes chemistry as mature field with slower current, future growth than that of other major sciences

David J. Hanson, C&EN Washington

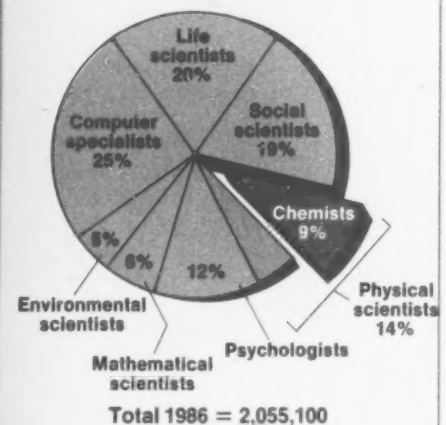
The first publication of a new series from the National Science Foundation provides a wealth of statistical information about chemists and chemistry. Titled "Profiles—Chemistry: Human Resources & Funding," the report includes charts and tables showing trends and the current status of the profession. Though the data are interpreted hardly at all, they show that some trends bode well for chemical scientists and that others are less favorable. In particular, the annual growth in employment for chemists is the lowest of all the major sciences.

The data are gleaned from three major surveys conducted every two years by the NSF staff of the Division of Science Resource Studies, each of which gathers data on occupation, highest degree obtained, and profession. These include an experience sample survey of more than 64,000 U.S. scientists and engineers based on information from the 1980 census, a survey on recent science and engineering graduates, and a survey of new recipients of doctoral degrees from U.S. colleges and universities, which samples about 57,000 persons. The first two surveys are used to make up the employment figures. From the three surveys, the number and status of chemists and other scientists and engineers are determined.

The data were organized by economist Melissa J. Lane of the NSF Scientific & Technical Personnel Characteristics Study Group. Lane says this type of review of an individual science has been on the back burner for a long time because data in the separate fields were often difficult to obtain. In the past, NSF has worked with a variety of professional societies, such as the American Chemical Society, in preparing data on some sciences. The chemistry profile is the first of the series, Lane says. The second will be on mechanical engineering and is expected out within the next month.

The data show that chemistry has been a reasonably healthy science over the review period from 1976 through 1986. Chemical research funding by the federal government, for example, has grown at a rate about equal to that for all sciences, not a bad record considering the rapid increase in funding for other areas, such as computer science. With regard to future human resources, women are moving rapidly into chemistry. NSF reports that all the growth in chemistry degrees at the baccalaureate level, about 4% in the past 10 years, has occurred because the number of women becoming chemists has doubled. In 1984, women represented more than one third of the baccalaureate recipients in chemistry. Other minorities, except Blacks, have shared this growth, NSF reports. Black doctoral chemists represent just 1% of the total, unchanged since 1975. The number of Asians receiving doctor-

Nearly 10% of all working scientists are chemists



Source: National Science Foundation

Industry R&D is the largest employer of chemists

Number of chemists	Industry	Education	Government: Federal	Government: State/local	Nonprofit organizations	Other[a]	Total
Basic research	3,000	6,600	1,000	500	600	200	11,900
Applied research	22,700	1,700	3,500	1100	1300	b	30,300
Development	30,700	200	1,000	600	300	b	32,900
R&D management	21,800	1,000	2,100	b	1100	b	26,100
Other management	19,400	2,200	900	1300	700	100	24,700
Teaching	200	24,800	b	b	b	100	25,100
Production/inspection	24,200	200	2,400	4400	400	200	31,900
Reporting, statistical work, computing	3,400	b	500	b	100	100	4,100
Other	6,600	200	b	300	500	600	8,100
TOTAL	132,100	37,000	11,400	8200	5100	1300	195,200

a Includes consulting, miscellaneous, and not reporting. b Too few cases to estimate. Source: National Science Foundation

New chemistry Ph.D.s are at all-time high after falling in 1970s

Number of Ph.D.s	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975
Agricultural/food	—	—	—	—	—	—	11	8	6	14	8
Analytical	285	228	264	190	229	185	207	178	174	152	142
Inorganic	251	233	215	226	188	189	195	201	198	226	229
Nuclear	7	18	13	20	12	14	14	13	24	25	21
Organic	493	525	503	519	494	484	469	454	479	497	605
Pharmaceutical	60	56	78	55	52	52	43	51	50	55	66
Physical	304	329	311	324	275	282	326	310	339	355	393
Polymer	84	63	62	50	62	61	67	57	55	42	40
Theoretical	48	37	48	32	33	47	50	48	38	48	46
Chemistry, general	214	183	177	175	193	157	128	161	146	144	169
Chemistry, other	90	93	88	89	74	67	58	65	62	66	57
TOTAL	1836	1765	1759	1680	1612	1538	1586	1544	1571	1624	1776

Source: National Science Foundation

al degrees has more than doubled during this period as have the numbers of native Americans and Hispanics who have earned Ph.D.s.

The report shows that chemists are more likely than all scientists combined to report some aspect of research and development as their primary work. This includes jobs in management as well as in the laboratory. Almost 39% of chemists are involved primarily in R&D laboratory work, and an additional 13% are in R&D management. The comparable figures for all scientists are 23% and 8%, respectively.

But the work chemists do varies considerably depending on the area of employment. NSF reports that nearly three fifths of chemists employed by industry work primarily in development (23%), production and inspection (18%), or applied research (17%). For chemists in the academic sector, most, as would be expected, are involved in teaching (67%), followed by basic research (31%). This, NSF finds, is actually a dramatic change from a decade ago. Since 1976, the share of chemists primarily involved in teaching has increased 10%, which means that a smaller percentage of chemists are presently doing basic research.

According to the NSF figures, the chemistry profession is suffering from a period of slow growth. The annual growth rate in employment of chemists of only 4% is half the rate for all sciences combined. Only the employment of medical scientists and oceanographers had lower growth rates. NSF's Lane says this is the result of the current balanced labor market in chemistry. Not many chemists are unemployed, she says, but at the same time the number of chemistry graduates isn't growing either. There has been a major shakeup in chemical employment, Lane says, stemming from a restructuring of the industry begun several years ago.

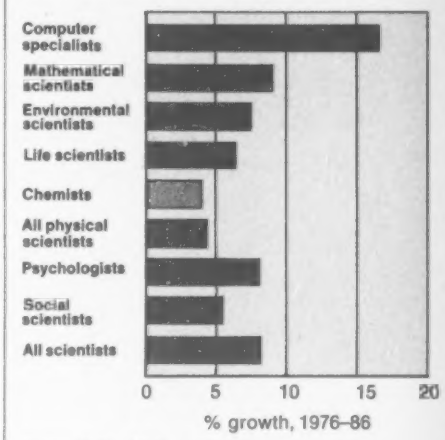
NSF finds that chemists' salaries are higher than those of the average scientist, but lower than those of other physical scientists, such as physicists. The average salary for chemists in 1984 is reported at $37,100 and at $34,500 for all scientists. The average salary for physicists is $44,200. Economist Lane says it is surprising that chemists' salaries are not higher, particularly because they are more likely to have a doctorate than are professionals in most other sciences.

Perhaps the slower job growth rate and declining enrollments are the basis for another finding. The average age of chemists is rising faster than that for all sciences. NSF reports that in 1986 almost 40% of chemists employed in the U.S. were more than 50 years old, compared with less than one third for all scientists. In 1976, three fifths of employed chemists were under 40 years old. In 1986, however, only 35% were under 40. For all scientists, 45% are less than 40 years old. On the other end of the scale, in 1986 only 11% of employed chemists were under 29 years old, whereas 16% of all scientists were less than 29. This means, of course, that as older chemists leave, there may be fewer experienced chemists to replace them.

Based on its data, the Bureau of Labor Statistics projects that employment in chemistry will continue to grow slowly over the next decade, probably 5 to 14% through 1995. This is expected to be less than the average growth rate for all sciences, as it has been for the preceding decade. The NSF report appears to concur, showing chemistry to be a mature field held steady by its large size and broad scope. Although the future of chemistry as a career is characterized as a declining one, chemists obviously can get steady work in a large variety of other related fields.

Single copies of the NSF report may be obtained from the National Science Foundation, 1800 G St., N.W., Washington, D.C. 20550. The full citation for the document is Profiles—Chemistry: Human Resources & Funding (NSF 87-307). □

Employment growth for chemists has been low for past decade



Source: National Science Foundation

Contract Labs Respond to Growing Demand for Analytical Testing

Commercial lab industry thrives on increasing call by companies, state and federal governments for drug, environmental monitoring

Ward Worthy, C&EN Chicago

Analytical chemistry, once merely a science, is now a fast-growing industry as well, thanks to Superfund and other legislation. Indeed, some modern analytical laboratories are really factories: Production lines process thousands of samples and computerized data systems turn out reams of paperwork.

According to various estimates, for-hire commercial labs had revenues of $250 million to $300 million in 1986 for environmental analyses alone. In-house environmental testing accounted for a similar amount. Drug testing brought another $200 million to $300 million. And, according to various predictions, the analytical services market will grow at a compounded annual rate of 25 to 40% over the next five years.

Fair to say, all this wouldn't be happening without the impetus provided by the U.S. and state governments. On the environmental side, for example, at least eight federal laws mandate laboratory analyses of one kind or another. Most of the recent growth in the lab industry has been generated by the Comprehensive Environmental Response, Compensation & Liability Act, better known as Superfund. However, compliance with the other laws—the Resource Conservation & Recovery Act, the Toxic Substances Control Act, the Clean Water Act, the Clean Air Act, the Safe Drinking Water Act, the Marine Act, and the Federal Insecticide, Fungicide & Rodenticide Act—also entails a lot of chemical analysis.

According to Stanley P. Kovell, special assistant to the director of the Environmental Protection Agency's Office of Emergency Remedial Response, it was obvious even before Superfund was passed that the agency's in-house laboratories could not deal with the expected influx of samples. So Kovell, in 1979, began to set up what came to be known as the Contract Laboratory Program (CLP), whereby private laboratories would furnish "state-of-the-art chemical analysis on a high-volume basis." Currently, Kovell says, Superfund accounts for about 95% of CLP's business. He notes, however, that CLP is designed to be "program neutral," and that work for non-Superfund clients is increasing.

The number of samples analyzed by private laboratories under CLP rose dramatically, from 1527 in fiscal year 1980 to 70,891 in fiscal 1985. In fiscal 1986, when Congress was wrestling with Superfund renewal and funds were in doubt, the number dropped slightly. This year, however, the operation is back in full swing. EPA estimates that just under 100,000 samples will be analyzed by CLP laboratories in fiscal 1987.

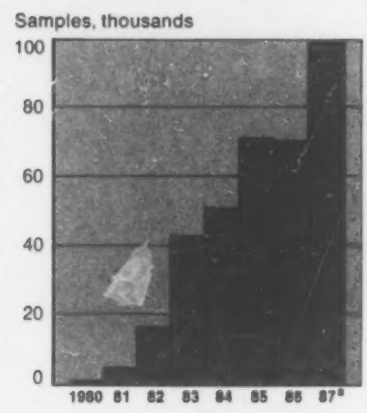
Moreover, CLP is only the tip of the iceberg. For example, Robert E. Finnigan, senior vice president of Finnigan MAT, a maker of gas chromatography-mass spectrometry (GC-MS) instrumentation and a major beneficiary of lab industry growth, estimates that U.S. environmental laws required the analysis of 150,000 to 180,000 samples in 1986. In addition, state and local governments accounted for 150,000 to 200,000 environmental samples and private industry for another 250,000 to 300,000.

Kovell: huge influx of samples

The CLP approach has wrought changes in the way analytical chemistry is done. It's no longer enough that an analysis be scientifically credible. According to EPA's Kovell, the underlying assumption is that the lab data will be used in litigation, with the government bearing the burden of proof. To provide "legally defensible" analytical results, the agency had to develop a program with a high level of quality assurance, extensive documentation, maintenance of chain-of-custody information on samples, and a high degree of intra- and interlaboratory consistency. Laboratories have to pass proficiency tests before they can bid on contracts.

When the program began, no validated EPA-approved methods were available. Therefore, developing and specifying analytical methods was one of the first orders of business.

Contract Lab Program analyses up sharply



Note: Fiscal years. a Estimated.
Source: Environmental Protection Agency

Methods have been refined through the years. Currently, CLP offers a menu of routine and special analytical services for inorganic analyses, organic analyses, and dioxin analyses.

Inductively coupled plasma (ICP) spectrometry is the method specified for most inorganic analyses. However, atomic absorption (AA) spectrometry is prescribed for elements such as mercury and selenium that aren't amenable to ICP. Colorimetric methods also are used. For organic analyses, GC-MS is prescribed. Dioxins, like other organics, are analyzed by GC-MS. However, some dioxins are highly toxic. They require special safety precautions, which not every lab can provide. Consequently, dioxins are handled under separate contracts.

The above description greatly oversimplifies things, of course. In fact, EPA publishes a thick user's guide to CLP that spells out in great detail what shall be done and how. Provisions are made for various types of sample matrix and for varying concentrations. Quality-control procedures are specified, as are documentation requirements.

It shouldn't be inferred that techniques other than ICP, AA, and GC-MS are somehow inferior, or that they have no place in environmental analysis. That's not the case. As just one example, although ICP and AA are the evidentiary methods for inorganic analyses, ion chromatography (IC) is also very useful in the field, particularly in wastewater and groundwater analysis. IC also can be used as a scanning tool for metals analysis with minimal sample preparation, with later confirmation by ICP or AA. Similarly, in drug testing, it's cost effective to use radioimmunoassay or enzyme immunoassay tests for preliminary screening; GC-MS is used only to confirm the suspected "positives."

Just the same, there's little doubt that CLP approval of a methodology is a boon to companies making the instruments that the methodology requires. For example, companies like Hewlett-Packard and Finnigan MAT, major producers of GC-MS systems, have benefited greatly from the fact that GC-MS is the approved CLP method for organic analyses.

Robert Finnigan, who pioneered the first commercial GC-MS systems, admits that his company lobbied hard to get EPA approval. And he enjoys the fact that Finnigan MAT has perhaps 65% of the market for GC-MS systems. He adds, however, that GC-MS is now more cost-effective than ever. For example, although the environmental market for analytical services will grow an estimated 35 to 40% per year over the next five years, the market for GC-MS—and for liquid chromatography-mass spectrometry (LC-MS) and mass spectrometry-mass spectrometry systems—will grow only about 20% yearly during the same period. There are two reasons for the difference in rates, Finnigan says. First, the laboratories increasingly will go to multiple-shift operation. Second, they will enjoy higher productivity with the newer analytical instrument systems.

As might be expected, there's a constant conflict between the need for standardization of procedures and the desire to use the latest and best procedures. Mark Carter, a senior manager at Enseco, one of the largest commercial labs, describes the situation.

"I spent seven years at EPA," Carter says, "so I know the dilemma it faces. The requirements to get new procedures adopted are agonizing. I believe it stifles the advancement of the science. But I don't mean to be critical of the agency. EPA has to balance between pushing the science along and yet making sure that the information it generates will stand up in court—because it is, after all, a regulatory agency."

Joan Fisk, manager of CLP's national organics program, agrees that nothing is going to displace GC-MS in the near future. "We're investigating LC-MS methods," she says, "but we're not ready to implement them." However, Fisk adds, methods are constantly being refined. Currently, a lot of attention goes to sample preparation and cleanup procedures.

Kovell admits that CLP's main mission necessitates that methods be standardized. However, he points out, methods development is another CLP mission, and CLP lets contracts for that purpose as well as for environmental analyses. Also, the laboratories operating under CLP provide an excellent means for validating new procedures under "real world" conditions. Quarterly "technical caucuses" bring together participants from all parts of the CLP organization for evaluation of analytical methodologies.

All true, says Enseco's Carter, but it's still a slow process. For instance,

Big laboratories expected to get bigger

	Professional staff[a]	Lab revenues, $ millions		
		1986	1987[b]	1988[b]
Enseco	425	$29.5	$36.5	$51.0
Environmental Treatment & Technologies[c]	400	20.3	28.0	35.0
CompuChem	400	15.2	25.9	32.4
International Technology[d]	400	20.7	23.7	29.0
Thermo Analytical	340	16.6	20.6	25.7

a Approximate. b Estimated. c Laboratory revenues calculated as 20% of company's total revenues. d Laboratory revenues calculated as 10% of company's total revenues. **Source:** First Analysis Corp.

Enseco and Perkin-Elmer are working together to promote inductively coupled plasma-mass spectrometry (ICP-MS) methods. Perkin-Elmer is furnishing the equipment and Enseco is developing applications and doing the "regulatory liaison" needed to get ICP-MS technology approved by EPA. Carter is optimistic about the eventual outcome, but he notes that it's been a long haul.

"There's so little effective communication between the research centers and the program offices," Carter asserts. "We feel the most effective way to get these new techniques approved is to collect the information that's required and communicate directly with the program offices. It isn't just a matter of showing you're doing good science. You've got to go through that agonizing regulatory setting. It's difficult, but it's essential."

The drive for increased productivity is also affecting the structure of the lab business. Steven F. Bouck, who tracks the analytical laboratory industry for First Analysis Corp., a Chicago research investment firm, notes that it's a highly fragmented industry with more than 500 players. Bouck estimates, however, that five of those companies will have combined lab revenues of more than $130 million in 1987. The five firms are Enseco, Environmental Treatment & Technologies Corp. (ETTC), CompuChem, International Technology Corp. (IT), and Thermo Analytical Inc.

Although small labs will continue to have their own niches, consolidation is occurring rapidly through mergers and acquisitions, Bouck explains. For example, Enseco was formed by the merger of Rocky Mountain Analytical Laboratory (Denver), California Analytical Laboratory (Sacramento), and several smaller firms. Rocky Mountain Analytical's special strength is inorganic analysis; California Analytical's is GC-MS. Similarly, Thermo Analytical, the laboratory arm of Thermo Electron, has acquired several smaller laboratories.

Several factors promote the use of the larger companies, Bouck says. For one thing, test requirements, as they become more sophisticated, require more expensive equipment. Also, the newer EPA contracts require greater sample throughput and more equipment redundancy. The larger labs offer a wider variety of services and equipment. And the larger labs are often perceived, rightly or wrongly, as having better quality-control programs. On the other hand, the smaller labs often have the virtues of being closer to their customers and responding more quickly to their needs.

Buyers of analytical services also may choose between companies that do nothing but lab work—like Enseco and CompuChem—and companies that are "vertically integrated" (that is, they also provide services in other areas of hazardous waste remediation, including engineering, consulting, transportation, and disposal). Among the larger companies, ETTC and IT are examples of the latter approach. Thermo Analytical is moving in that direction too. After merging with Thermo Water Management (another Thermo Electron subsidiary), it will be renamed Thermo Environmental.

Data management is an important aspect of modern laboratory operation

Both approaches have their pros and cons. The vertically integrated companies offer the convenience of "one-stop shopping" for hazardous waste problems, Bouck points out. However, their labs tend to be more specialized, with capabilities tailored to support the company's other operations. The lab-only companies usually offer a broader menu of lab services. And they're presumed to be more objective, because they have no other axes to grind.

Other factors play a role as well. For example, CompuChem, the leader in GC-MS analyses, favors the economies of scale that it can achieve with its one "megalab" at Research Triangle, N.C. However, CompuChem recently started a second lab in California, for the simple reason that a company has to have a lab in California to be "certified" there. In fact, the five largest lab companies all now have facilities in California.

Labs both big and small may bid for EPA contracts under CLP, once they have passed proficiency tests. And a lot of them have been bidding. According to EPA, a total of 91 labs had contracts under the program as of July 31. However, contracts are continually ending, new contracts are being let, and the num-

International Technology Corp. uses negative-pressure room for dioxin analysis

ber of participating labs has been increasing substantially.

At the same time, because contracts are awarded on a low-bid basis, the competition has driven prices down to what one lab spokesperson calls "ridiculously low levels." In fact, many of the smaller labs probably make little if any money on their CLP work. They seek it out just the same because acceptance into CLP provides a measure of credibility that they can use as a selling point in their dealings with private clients—who will end up paying considerably more per sample than EPA.

On the other hand, the labs don't want to be too dependent on government work. The Superfund slowdown in 1986 was hard on labs that didn't have other work to fall back on.

Among the problems facing the analytical lab industry, several lab executives mention a lack of qualified personnel. There is no shortage of analytical chemists, they say, but there is a shortage of people with the specific qualifications needed for environmental work, particularly in the GC-MS field and at senior levels. The major labs have recruiting programs and in-house training programs that have tended to ease the shortage somewhat. However, the demand has driven up salaries and has led to job-hopping.

Despite the essential role that computers play in the modern analytical laboratory, information management also continues to be a problem, especially for the largest labs. For example, Enseco's Carter says, "There isn't one laboratory information management system (LIMS) available that can support a company of our size, or support the sophistication of the work that we're doing." The difficulty, he says, is that existing systems, not having been designed specifically for environmental work, often aren't flexible enough to give the customers what they need. Therefore, Enseco is developing its own system. However, Carter adds, existing LIMS can be quite satisfactory for many laboratories. For that matter, a good "paper system" is often sufficient for smaller labs. □

Redesigned shuttle rocket test-fired

Nineteen months after the fatal explosion of the space shuttle Challenger that grounded most of its space program the U.S. last week reached a major technological and psychological milestone toward getting back into space: the first full-duration, full-size test firing of the shuttle's solid rocket booster, redesigned to eliminate the problems that caused the Challenger disaster.

In an atmosphere recalling launches into space from Cape Canaveral, dignitaries, the media, and thousands of members of the public gathered at a remote, barren mountain valley near Brigham City, Utah. For two minutes, the valley shook with the roar of a horizontal test firing of 1.1 million lb of solid propellant, and plumes of smoke shot thousands of feet into the air.

When this first "development motor" firing was over, officials of the National Aeronautics & Space Administration and of Morton Thiokol, prime contractor for the booster, pronounced the test successful, based on initial indications. However, they cautioned, it will take several weeks for engineers to take apart the rocket, inspect its parts, and make a full analysis of the results.

Their smiles were dampened somewhat by embarrassment over repeated delays of the test, postponing it by three days. The cause was not in the booster rocket, but in its ground support systems—a failed coupling in a water hose used to cool the booster, and difficulty after an aborted test in resetting the computers for the countdown.

Some 520 instruments monitored performance of the 126-foot-long, 12-foot-diameter booster. Thiokol and NASA have redesigned a number of features, including the exhaust nozzle at the rocket's rear and the case-to-nozzle joint. However, particular interest focuses on the three field joints—tang-and-clevis (tongue and groove) joints connecting the four rocket casting segments—which are usually assembled in Florida before launch. This is because failure of an aft field joint, allowing hot gases to pass through, caused the Challenger explosion.

When Thiokol engineers open up the rocket, the primary thing they'll be seeking is evidence of any hot gas getting through the field or case-to-nozzle joints.

Features added to the field joints to prevent such seal failure (C&EN, July 6, page 4) include a tang capture latch (an extra metal lip) and custom-fit shims that limit movement between tang and clevis. The new design also uses sealed insulation bonded with a pressure-sensitive adhesive (eliminating the problem-causing putty used in the Challenger boosters), and adds a J-shaped deflection relief flap to reduce stresses and increase sealing action under motor pressure.

Further changes include a third O-ring seal, longer clevis pins, and

Redesigned rocket joint adds heater, capture feature